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# PATENT SPECIFICATION

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DRAWINGS ATTACHED

(19)

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## (54) IMPROVEMENTS IN OR RELATING TO APPARATUS FOR THE PERIODIC RELEASE OF PELLETS IN PILL, TABLET OR CAPSULE FORM

(71) We, FLEET ELECTRONICS LIMITED, a British Company of 30 Tite Street, London, S.W.3., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to apparatus for the periodic release of pellets in pill, tablet or capsule form. Hitherto, the periodic release of known quantities of chemicals has been achieved either by hand (using measured quantities of dry or liquid chemicals or pellets in pill, tablet or capsule form) or automatic machines in which the chemicals are required to be used in liquid form. The disadvantage of the manual process is the high man-power cost. The disadvantage of the automatic machines using liquids is that they are either restricted to those chemical components whose properties are not degraded when mixed as a single reagent liquid, or they contain an expensive multiplicity of parts in order to keep reactive solutions apart until released.

It is an object of this invention to provide apparatus for the periodic release of chemicals in pellet form, that is to say comprising either pills, or tablets or capsules, which is automatic and therefore cheaper and less prone to error than manual release, and which by utilising dry chemicals enables pellet constituents to be used that cannot be used as a single liquid without interaction degrading or nullifying their properties.

According to this invention, an apparatus for the periodic release of pellets, in pill or tablet or capsule form, comprises a rotatable container or hopper for the storage of a supply of the pellets, a feed tube delivering pellets downward from the hopper in a single file column, the rotation of the hopper being arranged to impel fresh pellets from the supply to enter the upper end of the feed tube one after another, and a release cylinder or drum positioned just below the lower end of the feed tube and rotatable about a substantially horizontal axis, the release drum having at least one depression in its peripheral wall which passes beneath the end of the feed tube at each drum rotation, in an arrangement such that escape of pellets from the lower end of the feed tube is normally blocked by the presence of the drum except that each time the depression in the drum wall passes the tube end a single pellet drops into the depression and is thereby delivered from the apparatus as the drum rotation continues thereafter.

Preferably, the axis of the feed tube and the central axis of the hopper are coincident, with the hopper rotating about this common axis and the feed tube stationary.

If the hopper, holding a quantity of pellets, is rotated, and if the top end of the feed tube within the hopper is suitably shaped and the tube is of suitable internal diameter, then the resulting relative motion between the pellets, carried round *en masse* by the hopper, and the stationary tube will cause pellets to flow into the tube one at a time to form the desired single-file column. Furthermore, if the release drum rotation is appropriately synchronised with the hopper rotation it can be arranged that pellets are not removed from the lower end of the feed tube at a rate great enough to tend to empty the tube, having regard to the rate at which pellets are entering at the upper end.

To avoid the pellets inside the hopper becoming locked in a stable configuration preventing free flow into the tube, they may require to be subjected to an occasional gentle disturbance. This may be done, in some cases, by a stationary stirrer projecting into the top of the rotating hopper, but in the preferred arrangement stable pellet configurations are prevented by arranging that the axis of rotation of the hopper be inclined from the vertical and/or by providing a rib or wall on the inner base surface of the hopper, according to which best suits the form of the pellet being used. With this preferred arrangement the contents of the hopper experience less mechanical damage than when

a stirrer is used, the required agitation being achieved by gradual changes in the relative positions of the pellets under the influence of gravity as the body of pellets rotates with the hopper.

An apparatus for the periodic release of pills or tablets and construed in accordance with the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 shows the apparatus to be described in longitudinal half-section,

Figure 2 is a pictorial view of a feed hopper at the top of the apparatus, and

Figure 3 is a pictorial view of a release drum at the bottom of the apparatus.

A box-like structure 11 forms the main frame of the apparatus, and this structure may be provided with holes to receive screws whereby the apparatus can be secured to other complementary apparatus, e.g. to form a self-contained automatic detector of a specific chemical in a liquid sample.

Rotatably mounted in bearings 13 at the top of the frame 11 is a tube 12, which tube extends along the frame central axis and beyond the upper end of the frame, where it carries a bushing 10 providing a coned seating for the lower end of a rotary frusto-conical container or feed hopper 14. A pulley wheel 15 is fitted to the outside of the tube 12 to enable a rotary drive to be transmitted to the hopper 14 through a belt 15a. The hopper 14 holds a quantity of substantially spherical tablets or pills 40 and the rotation of the hopper will tend to carry the tablets round with it *en masse*. A second, non-rotary, tube 17 aligned coaxially with the axis of rotation of the hopper passes right through the frame 11 and through the rotary tube 12 into the lower part of the hopper. The tube 17 has its upper end 18 cut off obliquely and surrounded, within the hopper 14, by a rotary collar 16 the lower end of which is screwed into the bushing 10 while the upper end is enlarged to form a table 41 occupying substantially the entire cross-section of the hopper.

As can be seen, the axis of rotation 42 of the apparatus is inclined from the vertical. The pills 40 rest on the table 41 and tend to be transported round to the higher side of the table as it rotates; and the mutual arrangement of the table 41 and the oblique end 18 of the tube 17 is such that pills drop one after another into the upper end of the tube 17 which is of a diameter to receive only one pill at a time. To assist in sweeping the pills into the upper end of the tube the surface of the table 41 has an upstanding substantially radial wall or rib 19 acting as an impeller as the table rotates. The diameter and length of the tube 17 are such that the pills entering the upper end of the tube one at a time form a single-file column of pills 43 within the tube, thus ensuring that a pill is always present at the lower or delivery end of the tube 17.

Bearings (not shown) below the tube 17 support a shaft 21 the axis of which intersects the axis of the tube 17 at right angles thereto. A cylindrical release drum 22 is mounted on the shaft 21 beneath the tube 17, the distance of its peripheral wall from the tube end being such as to prevent a pill from emerging on to the curved surface of the drum, except where a single drilled depression 23 in this surface is brought into coincidence with the tube outlet once during each revolution of the drum which results in one pill dropping out of the tube. It will be appreciated that the rate of rotation of the drum 22 governs the rate of release of pills, one at a time, from the tube 17. Like the upper end, the lower end 44 of the tube 17 is also cut off obliquely to facilitate release of the pills. To ensure that each pill leaves the depression 23 a fixed ejector arm 45 is provided close to the rotating peripheral surface of the drum 22.

The release drum 22 is geared to rotate in synchronism with the hopper 14, both being driven by a common electric motor. In this example the drive ratio maintained between the hopper and the release drum is 1:1. The motor speed reduction gear may drive the hopper and release drum at, say, one revolution in every 30 minutes, resulting in a release rate of one pill every half hour.

It is advantageous to provide within the hopper 14 a diaphragm 46, situated at a level above the table 41 so as to sustain in part the weight of the body of pills 40 above the table and thereby keep the working conditions at entry to the feed tube 17 largely independent of changes in the quantity of pills in the hopper. This diaphragm 46 has an offset hole 47 through which the pills pass as the hopper rotates; and again there is a wall or rib 48 on the diaphragm next to the hole to promote the movement of pills through the hole.

It is intended that a transparent guide tube (not shown) beneath the release drum shall accept each pill or tablet as it drops from the drum and guide it to a receptacle (not part of this invention, but part of complentary apparatus) containing a sample of a liquid to be reacted upon by the chemical reagents of the pill or tablet. A photoelectric sensor adjacent to the guide tube may be arranged to generate an electric signal each time a pill or tablet passes through the tube. This signal is used by the complementary apparatus to start such sequence of events as may be required.

In one particular manner of use of the apparatus described, it is fitted to the complementary apparatus with the tube axis, and therefore the axis of rotation of the hopper 14, inclined at an angle of 20 degrees to the

vertical, in the plane of rotation of the release drum 22 and in a direction opposite to that of the drum rotation. The hopper is filled with a supply of, say, about 1000 pills or tablets. Electrical connection is made between the aforesaid photoelectric sensor and a sequence timer of the complementary apparatus. The electric drive motor is switched on and as the hopper 14 rotates pills flow down the feed tube 17 to the surface of the release drum 22 which is also rotating. The drum completes, say, one revolution in every half hour, and hence the single depression 23 in the drum passes beneath the outlet of the feed tube and collects a pill once in each half hour. The collected pill drops into the guide tube under gravity as the drum continues to rotate. The dropping pill is detected by the photoelectric sensor, whose output signal initiates the programmed sequence of events in the complementary apparatus.

It will be understood that to ensure the apparatus will operate reliably for long periods without attention it is necessary to exercise some care in the relative dimensioning of the co-operating parts. Thus, dimensions that are exactly equal to a pill diameter or a multiple of that diameter should be avoided in order to prevent pill jams. Some recommended dimensions are as follows: the diameter of the feed tube 17 may be about 1.1 or 1.2 times the pill diameter; the hole in diaphragm 46, $2\frac{1}{2}$ times the pill diameter; the walls or ribs 19, 48 one half times the pill diameter high and the distance between the table 41 and the diaphragm 46 greater than two but less than three times the pill diameter. The length of the tube 17 is not critical but ought to contain a sufficient store of pills or tablets to allow for misfeeds at the top end and to give enough weight to promote positive downward travel of the pills; a length of, say, 20 times the pill diameter or more is preferred. The angle of inclination of the apparatus is preferably in the range of 10 to 25° from the vertical.

Modifications of the apparatus illustrated are, of course, possible without departing from the scope of the invention as defined in the appended claims. Although the apparatus has been described as handling spherical pills, it is not restricted to this use but pills, tablets or capsules of other shapes can be fed; and naturally, the shape of the pills, tablets or capsules governs, to some extent, the configurations and dimensions of certain of the operative elements of the apparatus. In particular, the bottom end of the tube 17 must be carefully shaped and positioned, in the case of non-spherical tablets, to ensure that a tablet cannot drop back around the release drum in the wrong direction but will feed forward in the direction of drum rotation whatever its orientation. A gentle periodic striking of the lower end of the tube may assist but is to be avoided if the tablets are friable; on the other hand the mere fact of its association with mechanical moving parts may cause enough slight movement or vibration of the feed tube to accomplish the same result.

The shape and size of the depression in the release drum will naturally depend on the form and size of the pill, tablet or capsule to be delivered. Various drive ratios as between the hopper and the drum can be employed, so long as the pills, tablets or capsules tend to enter the upper end of the feed tube at a greater rate than they are removed at the bottom end.

The best angle of inclination of the apparatus will depend on the shape of the pills, tablets or capsules to be fed. In some cases it may be possible to operate successfully with zero inclination and/or without the walls or ribs on the hopper base and diaphragm. Stirring or agitation of the pills or the like in the hopper may be employed instead if the pills are well bonded and not friable.

It is important to ensure that, for example, an oversize tablet does not remain wedged in the depression 23 in the release drum to be carried right round and jam against the end of the feed tube 17. Instead of, or in addition to, the external ejector arm 45 an ejector may be incorporated within the cylinder, if desired. This can comprise a trapped free-falling ball, constrained to move loosely in a diametral bore within the drum 22 which terminates at the floor of the depression 23 in a hole of slightly smaller diameter than that of the ball. Once per revolution of the drum the ball will drop to the depression 23 and, protruding through the terminal hole, will strike a tablet wedged in the depression and eject it.

WHAT WE CLAIM IS:—

1. Apparatus for the periodic release of pellets, in pill or tablet or capsule form, comprising a rotatable container or hopper for the storage of a supply of the pellets, a feed tube delivering pellets downward from the hopper in a single file column, the rotation of the hopper being arranged to impel fresh pellets from the supply to enter the upper end of the feed tube one after another, and a release cylinder or drum positioned just below the lower end of the feed tube and rotatable about a substantially horizontal axis, the release drum having at least one depression in its peripheral wall which passes beneath the end of the feed tube at each drum rotation, in an arrangement such that escape of pellets from the lower end of the feed tube is normally blocked by the presence of the drum except that each time the depression in the drum wall passes the tube end a single

pellet drops into the depression and is thereby delivered from the apparatus as the drum rotation continues thereafter.

2. Apparatus according to claim 1, wherein the axis of the feed tube and the central axis of the hopper are coincident, with the hopper rotating about this common axis and the feed tube stationary.

3. Apparatus according to claim 2, wherein the common axis of the hopper and feed tube is inclined from the vertical.

4. Apparatus according to claim 2 or claim 3, wherein the upper portion of the feed tube passes up into the hopper through an outer bushing that rotates with the hopper, the bushing having an enlarged upper end that provides a bottom surface or base within the hopper.

5. Apparatus according to claim 4, wherein said bottom surface or base within the hopper has a rib or wall upstanding therefom to promote entry of pellets into the upper end of the feed tube as the hopper rotates.

6. Apparatus according to claim 4 or claim 5, wherein the hopper contains a pellet-supporting transverse diaphragm situated above the base of the hopper and having a hole offset from the hopper axis through which pellets fall into the space between the diaphragm and the base as the hopper rotates.

7. Apparatus according to claim 6, wherein the diaphragm has a wall or rib upstanding therefrom to promote passage of pellets through the hole.

8. Apparatus according to any one of the preceding claims, wherein the upper and/or the lower end of the tube is cut off obliquely or otherwise shaped to facilitate entry and/or exit of the pellets.

9. Apparatus according to any one of the preceding claims, wherein the rotary drives to the hopper and the release drum are so synchronised that there is no tendency for pellets to leave the lower end of the feed tube at a faster rate than they are entering at the upper end.

10. Apparatus according to any one of the preceding claims, wherein the axis of rotation of the release drum intersects the axis of rotation of the hopper, and the hopper axis is inclined from the vertical in the plane of rotation of the release drum and in the direction opposite to the direction of release drum rotation.

11. Apparatus according to any one of the preceding claims, comprising ejector means for ejecting pellets from the depression in the release drum.

12. Apparatus for the periodic release of pellets, substantially as described with reference to the accompanying drawings.

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1316174 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

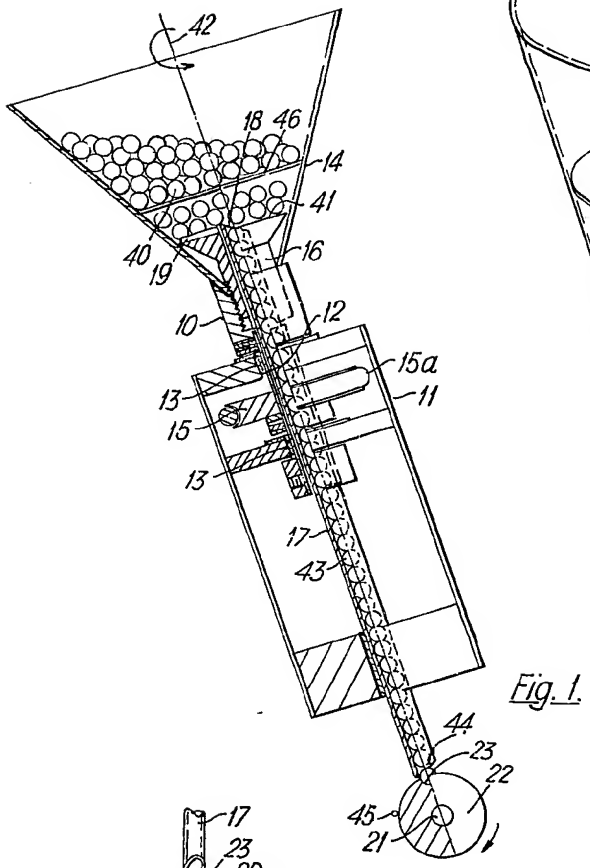


Fig. 1.

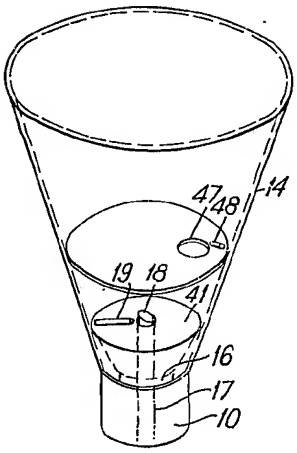


Fig. 2.

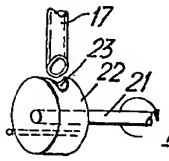


Fig. 3